inclination angles B,C illustrated in FIG. **2** as the chevron outlet diverges aft from the inlet bore **44** differently inclined at the inclination angle A.

FIG. **11** illustrates the corresponding EDM electrode **64** specifically configured for machining the curved chevron film cooling hole illustrated in FIGS. **9** and **10**. The electrode includes a cylindrical stem configured for machining the corresponding cylindrical inlet bore **44** at the shallow inclination angle A through the wall **32**. The base end of the electrode has opposite convex sides which diverge at the included angle D therebetween, with the lower face of the base end including a concave face for machining the complementary convex ridge **62** in this embodiment. The convex sides form complementary concave sides of the two troughs **48**.

It is noted that the three EDM electrodes **52**,**58**,**64** illustrated in FIGS. **5**,**8**, and **11** are similar in their coaxial alignment of the cylindrical inlet stems at one end and conical outlet cones at the opposite end. Those outlet cones are generally rectangular in cross section but suitably modified to include the two triangular planes in the lower surface of the FIG. **5** embodiment, the three triangular planes in the lower surface of the FIG. **8** embodiment, and the concave lower surface in the FIG. **11** embodiment.

The side walls in all three electrodes may similarly diverge at the included angle D, with the sidewalls in the FIG. **5** and **8** embodiments being generally straight or flat, whereas the sidewalls in the FIG. **11** embodiment being arcuate or convex.

The three electrodes may then be driven through the corresponding thin walls **32** at the shallow inclination angle A to form the corresponding symmetrical embodiments of the three compound chevron film cooling holes **38**,**54**,**60** disclosed above. Alternatively, the three electrodes may be driven through the wall with a compound inclination angle including the angle A in one plane and another shallow inclination angle in an orthogonal plane. In this case the resulting chevron outlet will be asymmetric.

The coaxial alignment of the opposite ends of the three electrodes permits additional divergence of the several chevron outlets illustrated in FIGS. **3**,**6**,**9** longitudinally outwardly from the corresponding cylindrical inlet bores **44**, and generally coaxial therewith. Not only does the chevron outlet in these embodiments diverge in the downstream, aft direction due to the compound inclination angles B,C, but the outlet preferably also diverges laterally coaxially with the inlet bore **44** as it increases in width downstream therefrom as illustrated in FIG. **3** for example.

This complex 3-D configuration of the compound chevron outlets in the several embodiments disclosed above permits tailoring of the different portions thereof for maximizing film coverage with corresponding flow diffusion for maintaining flow attachment as the corresponding jet of cooling air is discharged through the film cooling hole onto the outer surface of the thin wall being protected thereby. In the three basic embodiments disclosed above, the intervening ridge between the two wing troughs **48** has different configurations from triangular to truncated to convex which form corresponding lower boundaries for the two wing troughs.

The outboard boundaries of the two wing troughs are defined by the sidewalls of the troughs which may be generally vertical or normal with the wall outer surface, or may be arcuate or inclined as desired for the particular design application.

Furthermore, the leading edge portion of each chevron outlet preferably also diverges downstream from the outlet end of the inlet bore **44**, although in alternate embodiments it may be narrower in width to match that of the inlet bore itself.

In these various embodiments of the compound chevron holes, a substantial increase in film coverage due to the corresponding width E of the downstream end of the chevron outlets may be used to further increase efficiency of component cooling, and correspondingly increase efficiency of the engine.

For example, FIG. **1** illustrates an exemplary row of the chevron holes **38** being arranged colinear along the relevant span of the particular component wall **32**. Since each chevron outlet **42** may have an increased width compared with conventional film cooling holes, fewer holes are required along the span, which corresponding reduces the collective flowrate thereof

FIG. **6** illustrates another embodiment in which a pair of rows of the chevron holes **54** may be staggered from each other in span along the common wall **32**. The chevron or delta configuration of the chevron outlets **42** permits convenient overlapping thereof for promoting a laterally continuous film of cooling air along the span of the wall within the coverage of the film cooling holes. In this way, the cooling air discharged from the individual chevron outlets can laterally overlap and enhance the lateral continuity of the collective film cooling layer discharged from the rows of holes.

As indicated above, these various exemplary embodiments of the chevron film cooling holes may be used in any component of the gas turbine engine in which film cooling holes are typically used. The compound chevron hole outlets are readily manufactured using the corresponding EDM electrode to introduce new diffusion capability in the hole outlets for improving film coverage and flow attachment of the discharged cooling air jets.

While there have been described herein what are considered to be preferred and exemplary embodiments of the present invention, other modifications of the invention shall be apparent to those skilled in the art from the teachings herein, and it is, therefore, desired to be secured in the appended claims all such modifications as fall within the true spirit and scope of the invention.

Accordingly, what is desired to be secured by Letters Patent of the United States is the invention as defined and differentiated in the following claims in which we claim:

1. A gas turbine engine wall comprising:

opposite inner and outer surfaces having a row of compound chevron film cooling holes extending longitudinally therethrough and diverging both longitudinally and laterally between an inlet at said inner surface and a chevron outlet at said outer surface; and

each of said chevron holes including a cylindrical inlet bore commencing at said inlet in said inner surface and terminating in a pair of wing troughs having a common ridge therebetween.

2. A wall according to claim **1** wherein:

said inlet bore is inclined between said inner and outer surfaces;

said wing troughs diverge longitudinally between said inlet bore and said outer surface, and laterally along said ridge; and

said chevron outlets increase in lateral width longitudinally along said ridge as said ridge decreases in depth to maximize diffusion with minimal flow separation of cooling air channeled through said chevron holes.

3. A wall according to claim **2** wherein:

said bore terminates below said outer surface; and